Optimizing HULK STPE & HULK WP Performance

with Fumed Silica (Gel)

Fumed Silica, also known as pyrogenic silica, is a synthetic, amorphous silicon dioxide (SiO_2) that acts as a versatile chemical additive. It is typically referred to as the "Gel" type in your internal context



Thickening Mechanism

The surface of the particles is covered by highly reactive silanol groups (Si-OH). These silanol groups enable the formation of reversible hydrogen bonds between particles, creating a 3D lattice network structure. This network restricts movement, which increases the viscosity of the liquid system.

Chemistry & Synthesis

Synthesized via the hydrolysis of silicon tetrachloride in an oxyhydrogen gas flame at very high temperatures (flame hydrolysis). The process creates microscopic droplets that fuse into chain-like 3D aggregates and then agglomerate into larger tertiary structures. It is of high purity (>99%) and low density.



Structure

A fine nanopowder made of amorphous silica particles that are extremely small (7-40 nm average particle size). It has an extremely large surface area (e.g., 35 m^2/g to 320 m^2/g).

Thixotropy

The additive is highly thixotropic. When subjected to shear stress (e.g., stirring or application), the 3D lattice breaks down, causing the viscosity to decrease (shear-thinning), allowing for easier flow and application. Once the stress is removed and the liquid is at rest, the structure builds back up, and the viscosity is restored.

Types

Available in hydrophilic (untreated, water-attracting) and hydrophobic (silane-treated, moisture-resistant) grades.

General Uses: Fumed silica is widely used in coatings, paints, and adhesives as a rheology modifier to control flow, impart anti-settling, prevent sagging, and add reinforcement. A higher surface area (BET value) generally results in a stronger thickening effect.

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with Thixotropic Thickening Powder (Fibres)

Thixotropic Thickening Powder, often made of fumed silica, is a white, free-flowing powder used as a thickening agent in coatings and resins.





Thickening Mechanism

Thickening in fibrous materials typically occurs through the physical entanglement and binding of the fibers within the liquid system, creating a highly structured and physically reinforced network.

Chemistry & Structure

No specific chemical details are provided in the available context. The material is identified by its physical structure as Fibres, which suggests a composition like cellulose or certain mineral fibers, as opposed to the amorphous silica nanoparticles.

Thixotropy

It is classified as a Thixotropic Thickening Powder, meaning its structure breaks down under shear (stirring, application) and rebuilds quickly at rest to prevent sagging.

Sag Resistance

It prevents the coating or resin from running off or sagging when applied to vertical or overhead surfaces.

Workability

It allows the material to flow and spread easily during application (when shear stress is applied), but quickly regains its thickness to maintain stability and prevent dripping when the movement stops.

General Uses: Thixotropic Thickening Powder (fumed silica) involve acting as an effective thickening and reinforcing agent to control viscosity and prevent sag or settling across applications like coatings, resins, adhesives, and sealants.

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Fumed Silica vs. Thixotropic Powder

HULK Product Goal	Fumed Silica (Gel) High-Precision Rheology	Thixotropic Powder (Fibres) Structural Build
Maximize Anti-Sag & Flow Control	BEST CHOICE. Achieves excellent anti-sag and anti-settling (suspension of heavy particles) due to a uniform, reversible network. Ideal for high-end flow control.	Effective, but the thickening mechanism is less refined for ultra-smooth rheology compared to nanoparticles.
Need to Fill Large Voids (High Build)	Less effective. The nanoparticulate structure is primarily for network control, not bulk filling.	BEST CHOICE. The fibrous structure is physically better suited for bridging gaps and providing structural reinforcement/bulk in high-build applications.
Hulk STPE & Hulk WP Compatibility	Fully compatible. Hydrophobic grades are often preferred for moisture sensitivity in STPE and less polar systems.	Confirmed as a suitable additive for customizing Hulk STPE viscosity without diluting core chemistry.
Film Transparency/Clarity	Good. The material is often used for its minimal impact on film clarity when properly dispersed.	May introduce a subtle texture or opacity due to the physical size and nature of the fibers.

Key Takeaway

Fumed Silica (Gel) for refined rheology control, superior particle suspension, and an optimal anti-sag result in standard film thickness.

Thixotropic Thickening Powder (Fibres) when the primary application requires filling substantial cracks and voids, utilizing the structural strength of the fibers to build film thickness and prevent slumping.

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